carry phenocrysts of olivine and augite, but none of feldspar. The groundmass is extremely fine grained and is in part obscured by alteration products. It is basaltic to a great extent, but contains orthoclase in microscopic crystals, or else shows upon analysis a relatively high content of alkalies. Mica is also a prominent constituent in some instances. Professor Merrill's remark upon the mutual interference of the phenocrysts of augite and olivine, namely, that it "can be accounted for only on the supposition that neither mineral is a direct secretion from the magma, but that they are residuals of an earlier crystallization in which consolidation had proceeded so far that free growth was no longer possible," appears to the reviewer to be greatly in error. One need only mention the pegmatitic intergrowth of phenocrysts of quartz and orthoclase in certain obsidians and pumices, and the mutual penetration of pyroxene and hornblende in phenocrysts in some glassy andesites. Chemically the rocks belong with lamprophyres, and resemble some rocks found in the Absaraka Range, in the Yellowstone National Park.

The porphyrite-like rocks carry phenocrysts of plagioclase in addition to those of augite and olivine, and have a groundmass in which orthoclase occurs in connection with plagioclase. The syenitic rocks are closely associated with the lamprophyric ones: and in one case the chemical composition of the syenite is very similar to that of the sodalite-syenite of Square Butte, Highwood Mountains, Montana, as pointed out by Professor Merrill. The reviewer hopes to be able to present shortly in this JOURNAL an account of the closely related series of rocks occurring in the neighboring region of the Yellowstone Park, to which Professor Merrill has referred in his article.

J. P. I.

Highwood Mountains of Montana. By WALTER H. WEED and LOUIS V. PIRSSON. Bull. Geol. Soc. Am., Vol. 6, pp. 389–422. Pls. 24–26. Rochester, April 1895.

The situation and topographic features of the Highwood Mountains are briefly described, and the geologic structure of the district is pointed out. The mountains consist of the denuded remains of volcanoes whose rocks show extreme differentiation of a highly alkaline magma. There are several volcanic cores now filled with massive granular rock. These are surrounded by tuffs and volcanic breccias with lava-flows and a great number of radiating dikes.

The main mass of mountains consists of basaltic breccias resting upon Cretaceous sediments, and also upon acidic tuffs and breccias, which are earlier than the basaltic rocks. The radial disposition of the dikes is one of the most marked characteristics of the geologic structure, and is well shown on the map. The soft Cretaceous strata consist of sandstones and clayey shales belonging to at least two groups; the lower referred to the Kootenia, the upper possibly representing a southward development of the Belly River formation. The strata are nearly horizontal or but slightly inclined away from the mountains. In the vicinity of the volcanic cores the sedimentary rocks are metamorphosed into dense hornstones and quartzites, quite like the baked Algonkian slates or Cambrian shales of Castle Mountain, or the metamorphosed Livingston beds about the volcanic core in the Crazy Mountains.

The chief interest of the region is in the character and occurrence of the igneous rocks, and in the differentiations of magmatic material that has taken place at each of the volcanic cores. The South and Highwood cores consist of syenite; from them radiate dikes of basaltic rocks, in part leucite or analcite-basalt; in part dark rocks with large plates of black biotite. Complementary rocks in the form of porphyries also occur. About the Highwood core the first rocks erupted were acidic tuffs and breccias, intermingled with flows of felsite and possibly phonolite. These were succeeded by breccias and lavas of basaltic material similar to the dikes just mentioned. The east core is of syenite, partly surrounded by basaltic lavas and breccias.

The Shonkin core is the largest in the district and consists of granular rock, in one place breaking up through basaltic breccia. The Arnoux core is of similar granular rock, which breaks through acidic tuffs and basaltic lavas.

Palisade Butte is a volcanic core of coarsely crystallized basic rock like that in Square Butte, and called shonkinite. It is a columnar mass topped by syenite which appears to have been extruded through the shonkinite. The rocks mentioned in connection with these cores have not yet been described in detail but are said to be of novel types and of great interest petrologically. At Square Butte, an eastern outlying mountain of this group, the character of the igneous rocks is such that they have been specially described. The butte is a flat-topped mass rising 1700 feet above its base. The igneous rocks form a laccolite once covered by Cretaceous strata, now almost completely bared of its covering. The topographic character of the mountain and

the forms of erosion assumed by the rocks are shown in numerous illustrations.

The lower half of the rocky slopes of the mountain consists of dark-colored rock eroded into towers and spires, which are strongly contrasted with the light-colored upper half of the mountain, where the rock is in large masses and cliffs. The white rock is sodalite-syenite, already described by Lindgren, the petrographical characters of which are briefly reviewed. The dark rock is a new type of rock consisting of much augite and less orthoclase, besides olivine, biotite, albite, anorthoclase and accessory nephelite, sodalite and other minerals. The chemical composition of the rock, and that of the pyroxene are given, and the mineralogical features of the rock are fully described. The name shonkinite is proposed for the new rock. The two rocks of the laccolite form one mass, erupted at one time; the marked differences between them being the result of differentiation subsequent to their intrusion within the sedimentary rocks. The process of differentiation is discussed at length, and the opinion is expressed that no one simple process will explain all cases, but that a variety of factors must be taken into account, any one or all of which may operate to produce a given phenomenon. J. P. I.

The Laccolitic Mountain Groups of Colorado, Utah and Arizona. By WHITMAN CROSS. Fourteenth Annual Report of the Director U. S. Geological Survey, for 1892–3. Washington, 1895. 84 pp., 10 Plates, 19 Figures.

Having become familiar with numerous instances of laccolitic intrusions in Colorado, and having noted how much doubt concerning their true nature existed in the minds of some foreign geologists, Mr. Cross has undertaken to present the facts already known of such bodies of igneous rocks, so far as concerns their occurrence in regions explored by himself and in the neighboring regions of Utah and Arizona. And in so doing he has endeavored to establish more clearly the various phases of laccolitic intrusions within sedimentary strata, and to describe the petrographical character of the igneous rocks that constitute such intrusive bodies. The paper first reviews in considerable detail the facts established by Gilbert regarding the laccolites of the Henry Mountains, and the theory he advanced in explanation of them. It also reviews the characters of the rocks from a study of the specimens collected by Gilbert and originally described by Dutton. According